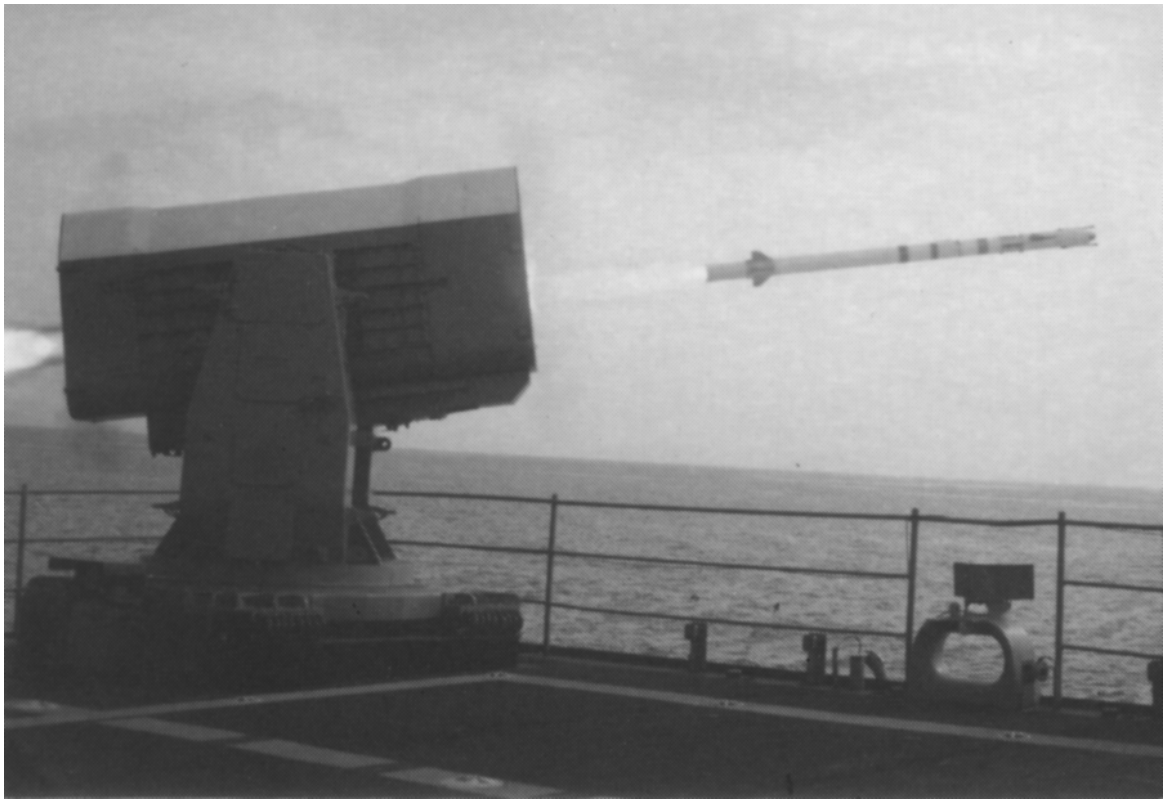
# ROLLING AIRFRAME MISSILE (RAM) WEAPON SYSTEM



**Navy ACAT II Program**

| | |
|---|---|
| Total Number of Systems: | 1,315 Blk 0 missiles.<br>3,195 Blk 1 missiles.<br>710 Blk 1 retrofit kits.<br>156 Launchers |
| Total Program Cost ((TY$): | $3,786.1M |
| Average Unit Cost (TY$): | $0.273M Blk 0<br>$0.444M Blk 1<br>$4.4M GMLS |
| Full-rate production: | Block 0: FY94<br>Block 1: FY00 |

**Prime Contractor**

Raytheon Systems Company,
Tucson, AZ

## SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Rolling Airframe Missile (RAM) program is designed to provide surface ships with an effective, low-cost, lightweight, self-defense system that will provide an improved capability to engage and defeat incoming anti-ship cruise missiles (ASCMs). The RAM Block 0 has a five-inch diameter airframe that rolls in flight and dual mode, passive Radio Frequency/Infrared (RF/IR) guidance. Initial homing for RAM Block 0 is in RF, using an ASCM's RF seeker emissions. If the ASCM's IR radiation is acquired, RAM transitions to IR guidance. RAM Block 1 uses an improved, electro-optical proximity fuze and a new IR seeker, and can be launched in an IR all-the-way mode as well as the dual mode

(passive RF, followed by passive IR) used by Block 0. Block 0 rounds are being configured with the new electro-optical fuze used in RAM Block 1. The launching system and missiles comprise the weapon system.

RAM weapon systems are integrated with the AN/SWY-2 or -3 combat system on certain ships and with the Ship Self Defense System (SSDS) Mark 1 on other ships. The AN/SWY-2 is comprised of the weapon system and the combat direction system. With the SWY combat system, RAM has targets assigned or designated to it by the Mk 23 target acquisition system radar operational computer program. This program integrates ship sensor information and performs threat evaluation and weapon assignment on DD 963-class, LHA-class, LHD-class, and CV class ships. Within the AN/SWY-3 combat system, RAM provides a short-range air defense capability, with the NATO Sea Sparrow system providing longer range protection. For CVN-class and LPD 17-class ships, it is planned for the Cooperative Engagement Capability to integrate radar information and provide threat evaluation. SSDS MK 2 will perform weapon assignment. For LSD 41-class ships, the Ship Self Defense System MK 1 integrates ship sensor information and performs threat evaluation and weapon assignment. For example, on LSD 41 class ships, a typical SSDS engagement suite includes RAM, the PHALANX Close-In Weapon System Block 1A, and the decoy launch system. SSDS further integrates the AN/SPS-49(V)1 radar with the medium pulse repetition frequency upgrade, the AN/SPS-67 surface search radar, the AN/SLQ-32(V) sensor, and the CIWS search radar. The RAM weapon system will be upgraded with a RAM Helicopter-Aircraft-Surface (HAS) target mode.

RAM Block 0 contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by enhancing ship self-protection against several RF-radiating ASCMs that have "leaked" past outer air defenses. RAM Block I extends that protection against several non-RF radiating missiles. Given that some of the ships using RAM are also platforms from which strike operations are executed, RAM indirectly contributes to the concept of ***precision engagement***.

## BACKGROUND INFORMATION

The Navy established an operational requirement for the RAM weapon system in 1975. The Federal Republic of Germany and the United States signed a memorandum of understanding for joint participation in the advanced development phase of the program. IOT&E was completed in FY90. The DOT&E assessment was reported in DOT&E's FY90 Annual Report. As noted in that report, a B-LRIP report had been prepared for RAM but a final decision to proceed beyond LRIP had not been made. Due to this deferred decision, the B-LRIP report was not forwarded to the congressional defense committees until April 1994, prior to Block 0 missile and launcher full-rate production. The B-LRIP report concluded that the RAM weapon system was operationally effective against the preponderance of RF-emitting ASCMs, although there were exceptions. It also concluded that RAM Block 0 was not operationally suitable. These deficiencies were addressed prior to the decision to proceed beyond LRIP, with the new Block I missile program addressing the more fundamental deficiencies.

RAM Block 1 OPEVAL was completed on the self defense test ship in August 1999. Results of that OPEVAL supported the conclusions in DOT&E's B-LRIP and LFT&E report that RAM Block 1 is operationally effective and lethal against most current ASCMs, and is operationally suitable. An accompanying caveat was that the conclusions could not be decoupled from the combat system (that for the LSD 41-class of ships) that was simulated on the self defense test ship.

## TEST & EVALUATION ACTIVITY

Activity consisted of planning for FOT&E of RAM Block 1 and for T&E of the RAM HAS target mode.

## TEST & EVALUATION ASSESSMENT

RAM Block 0. Our assessment of RAM Block 0 remains that it is operationally effective against most of the RF-emitting ASCMs and that it is operationally suitable. Performance against targets executing evasive maneuvers has not been tested because these targets were not available, nor was the SDTS available for OT of RAM Block 0 against the most realistic threat attack profiles.

RAM Block 1. RAM Block 1*, as supported by the SSDS Mark 1, integrating an AN/SPS-49A search radar, a CIWS Block 1B, and an AN/SLQ-32(V)3 electronic warfare system,* is operationally effective against most current ASCMs. *The CIWS Block 1B radar was essential in tracking targets and supporting RAM Block 1 launches. By no means can the operational effectiveness assessment of RAM Block 1 be divorced from the combat systems suite used in testing.* RAM Block 1 is operationally suitable. RAM Block 1 is lethal against most current ASCMs.

Assessment of RAM Block 1 when supported by other combat systems (especially any without CIWS Block 1B) will require independent OT with that particular combat system on this or a follow-on SDTS. RAM Block 1 capability was examined against representative targets from all ASCM threat categories but one. That category is projected to have slow expansion and is currently populated by a single threat. A surrogate target is being developed for FOT&E to investigate RAM Block 1 capability in this category.

The FOT&E program for Block 1 needs to address the following, extracted from our B-LRIP report:

- Missile capability against the threat category that was not tested during OPEVAL.
- Missile survivability after the requisite storage time in a shipboard launcher.
- Missile capability against ASCMs under conditions of EA to the combat system sensors, low visibility (high aerosol environment), and other IR sources.

RAM HAS Mode. The RAM program sponsor directed initiation of efforts to use inherent Block 1 capabilities, via software modifications, to enable engagement against helicopter, aircraft, and surface targets. This direction stipulates that resident Block 1 ASCM capability is to be retained. It is understood that the program sponsor intends to issue detailed performance goals for the RAM HAS in FY02 after completion of a performance characterization/evaluation phase. More definitive operational requirements are critical for laying out an effective T&E program, given the absence of an ORD. The T&E program for the HAS mode will address retention of Block 1 capability against ASCM threats.

## LESSONS LEARNED

The OPEVAL of RAM Block 1 is considered the most operationally realistic and stressful testing of a Navy air defense missile system—ever. That this was achieved is due both to the Program Manager's cooperation in obtaining threat-representative targets and the availability of the SDTS. This

unique test asset allowed thorough examination of RAM Block 1 within its intended operational environment. Significant information regarding capabilities and limitations was learned during this operationally realistic testing, which could not have been obtained otherwise, short of use in combat.